

OROVILLE FACILITIES RELICENSING (PROJECT NO. 2100)

FINAL REPORT SP-F3.1, Task 2D

MANAGEMENT PRACTICES AND MONITORING STUDIES FOR WHITE STURGEON

REVIEW DRAFT

PREPARED BY:



Contact: David Olson
Telephone: (916) 563-6360

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EXECUTIVE SUMMARY

A literature review was conducted to summarize management activities and the results of monitoring studies designed to determine the effectiveness of various management activities for white sturgeon (*Acipenser transmontanus*). It was the intent that the reviewed studies would provide a mechanism for developing a potential sturgeon management plan and provide a framework for evaluating the likelihood of success of such a program in Lake Oroville. Limited information was available for white sturgeon populations within California reservoirs, as there is little active management of sturgeon in California reservoirs. Therefore, reports detailing sturgeon management activities and monitoring studies from the Pacific Northwest region, primarily the Columbia River Basin, were reviewed. The studies reviewed suggested that the particular habitat that sturgeon prefer to spawn in occurred in the swiftest water available; on substrates consisting mainly of cobble, boulder, and bedrock; in water temperatures ranging from 12°C - 18°C (53.6°F – 64.4°F); and at depths of 4-24 meters (13 – 79 feet). There may be small portions of the North Fork Feather River and Middle Fork Feather River that provide the preferred spawning habitat for white sturgeon; however, additional information is needed to determine the quantity and availability of sturgeon habitat. Without the proper spawning habitat availability, white sturgeon populations may not be sustainable; consequently, management practices used in the Pacific Northwest may not be applicable to Lake Oroville.

INTRODUCTION

The following study was designed to summarize information regarding management practices from reservoirs that are actively managed for sturgeon. In addition to evaluating potential project effects, this study was designed to provide baseline information useful for future evaluations and development of potential Protection Mitigation and Enhancement (PM&E) plans. One potential PM&E may include active management of Lake Oroville for sturgeon. Therefore, a literature review summarizing management activities and the results of monitoring studies designed to evaluate the effectiveness of various management activities will provide a mechanism for developing a potential sturgeon management plan, and for evaluating the likelihood of success of such a program in Lake Oroville. Lake Shasta management policies, monitoring and tagging studies, and progress reports have been reviewed and summarized for their potential applicability to Lake Oroville. Similar information from other Western United States reservoirs that are managed for sturgeon also have been reviewed and summarized for their applicability to Lake Oroville.

In general, Lake Oroville thermally stratifies in the spring, destratifies in the fall, and remains destratified throughout the winter. Lake Oroville supports a two-story fishery, which means that it supports both coldwater and warmwater fish species that are thermally segregated for most of the year. The coldwater fish use the deeper, cooled, well-oxygenated hypolimnion, whereas the warmwater fish are found in the warmer, shallower, epilimnetic and littoral zones. When Lake Oroville destratifies, the two fishery components mix in their habitat utilization. White sturgeon is considered a coldwater fish and prefers a habitat that varies from 0° to 24°C (32°-75.2°F) (Parsley et. al, 1993). Project operations influence habitat for coldwater fish by manipulating the amount of coldwater in Lake Oroville. Cold water is taken from Lake Oroville's hypolimnium for the purpose of supplying cold water to the downstream fishery in the main channel of the

Feather River, thereby potentially limiting the amount of coldwater available for fish species in Lake Oroville. In 1968, the California Department of Fish and Game (DFG) stocked 31 white sturgeon in Lake Oroville. In 1998, a private fishing group stocked 1000 fingerling white sturgeon in Lake Oroville with the permission of DFG (E. See, pers. comm., 2002). White sturgeon are still reported to occur in Lake Oroville, with occasional observations of fish jumps and fish catches.

METHODS

A literature review was conducted of various studies and management plans previously prepared for white sturgeon. Studies related to white sturgeon were used due to the fact that there is limited information available on green sturgeon populations. The collective of agencies for the Oroville FERC relicensing project agreed that white sturgeon information was an acceptable surrogate for the green sturgeon. The studies used included:

- The Shasta Lake Sturgeon Fishery, CA;
- Spawning and Rearing Habitat use by White Sturgeons in the Columbia River downstream from McNary Dam, WA;
- Movements of White Sturgeon in Lake Roosevelt, WA;
- Evaluate the success of developing and implementing a management plan for enhancing production of white sturgeon in reservoirs between Bonneville and McNary Dams, WA.

Each study had varying information on the type of spawning habitat that sturgeon prefer, the white sturgeon population in reservoirs, as well as any mitigation and restoration plans in place for management of the white sturgeon population. Each study was reviewed in detail for the results and management plans to determine if this information was applicable to Lake Oroville.

In addition, correspondence was sent to individuals at various resource agencies to determine if information was available for white sturgeon management in any reservoir in California. Agencies and their representatives that were contacted included California Department of Fish and Game (Ray Schaffter, Dennis Lee, Dave Kohlhorst, John Hiscox, Mike Meinz, Randy Kelly, Randy Benthin, Gary Stacey, and Chuck Knutson) Department of Water Resources (Alicia Seesholtz, Ted Sommer, Bradley Cavallo, Michael Perrone, and Eric See), University California Davis (Serge Doroshov and Joe Cech), and NOAA (David White and Eric Theiss).

RESULTS AND DISCUSSION

The Shasta Lake Sturgeon Fishery (1963) study was done by DFG to determine the effect of night fishing in Shasta Lake on the sturgeon population, and what sizes of sturgeon were being caught. The number of fish caught was monitored over a six-month period, starting in May. The study found that 104 sub-legal sturgeon were caught over the six-month period, while 25 legal sturgeon were caught over the same time period (DFG 1963). All sturgeon caught were classified as white sturgeon, and most sturgeon caught were in the Pit River Arm of the lake. It was determined that the number of legal-sized sturgeon landed was not large enough to have an adverse effect on the sturgeon population. However, since that study, the white sturgeon population in Shasta Lake may have become extirpated or remains present at very low numbers

due to the construction of Pit 6 and 7, which may have effectively eliminated the habitat that white sturgeon had used for spawning (R. Schaffter, pers. comm., 2002). As a result, a pen rearing program for white sturgeon was begun at Lake Shasta and was successful for growing sturgeon. However, shortly after it was begun, it was determined by a DFG pathologist that the fish, obtained from a private aquaculturist, were infected with a viral disease. This virus may only occur in hatchery-reared sturgeon and not in the wild population, so the hatchery population was destroyed and the decision was made not to stock the sturgeon in the lake.

The above study suggests that the sturgeon population seems to have preferred the Pit River Arm of the lake, as most of the sturgeon were caught in this location. It is logical to surmise that if a white sturgeon population persists in Lake Oroville, they would most likely be found in the North Fork Feather River and Middle Fork Feather River that flow into Lake Oroville.

The study titled *Spawning and Rearing Habitat use by White Sturgeons in the Columbia River downstream from McNary Dam* (1993) was conducted by the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS). The goal of the study was to determine and describe the type of habitat that white sturgeon use for spawning and rearing. The study described the habitats by water temperature, depth, velocity measurements, and substrate types present at sites where eggs, larvae, young-of-the-year, and juveniles were collected. The samples were collected over a period of five years in the Columbia River downstream from McNary Dam to the mouth. This river reach is divided into three impoundments and one unimpounded river reach. The impoundments are classified as those reaches of the river between two dams and include the Bonneville Pool, the Dalles Pool, and the John Day Pool. Each pool was sampled for physical habitat use by the white sturgeon. It was concluded that spawning occurred in the swiftest water available (mean water column velocity of 0.8 to 2.8 m/s) and on substrates consisting of mainly cobble, boulder, and bedrock. Spawning occurred at water temperatures ranging from 12°-18°C (53.6°-64.4°F), and at water depths of 4-24 meters (13 – 79 feet).

In order to achieve a self-sustaining sturgeon population within Lake Oroville, suitable spawning habitat must be present. The above study was used to determine the type of habitat that sturgeon prefer to spawn in. It was found that the spawning sturgeon tend to prefer an area that is deep and cool with swift water currents, and has a main substrate of rocks. Relatively little information is presently available regarding substrate composition and distribution in Lake Oroville or its inflow streams. However, there is a potential for suitable habitat to be present in the North Fork Feather River and Middle Fork Feather River, as well as the West Branch Feather River (E. See, pers. comm., 2002). This habitat type tends to be present particularly in the winter and spring months, when flows in the rivers are higher and the lake level is higher. Water temperatures within the North and Middle forks range from 35°-75°F (DWR 2001), which encompasses the range of suitable spawning temperatures. In addition to Lake Oroville tributaries, the Diversion Pool, especially in the upper portions nearest the Thermalito Dam, may meet the criteria for spawning. Water temperatures within the Diversion Pool stay in the high 50°F range (DWR 2001).

However, it is uncertain whether the portions of the rivers and Diversion Pool are large enough to constitute suitable habitat for a self-sustaining spawning population. In addition, there is little information available about the type of substrate and water velocity found in either location, so

there is no determination if the substrate and water velocity within these potential suitable habitats are in fact within the range of conditions suitable for sturgeon spawning.

Some portions of the North Fork Feather River may contain the preferred spawning habitat (i.e., bedrock substrates with fissures and large cobble substrate with relatively high water velocities). When sections of the North Fork Feather River are inundated when flows are high and Lake Oroville is at high pool. Specifically, the area below Big Bend Dam contains large boulders with water depth ranging from 15-25 feet, which may provide suitable spawning habitat for sturgeon (B. Ross, pers. comm., 2002). However, water velocity distributions have not been developed for this area.

The Agricultural Institute at the University of Idaho prepared the study titled *Movements of White Sturgeon in Lake Roosevelt* (1992) Lake Roosevelt is the most upstream impoundment on the Columbia River, located behind Grand Coulee Dam in the state of Washington. The study was conducted to determine sturgeon movement in Lake Roosevelt in an attempt to define habitat use in a river/reservoir system. Sonic tags were placed onto sturgeon and then monitored from April 1988 through June 1990. Sediment samples also were taken to compare river bottom composition with substrate size associated with sites preferred by the sturgeon. The data collected showed that the habitat preferred was the low water interface between the reservoir and river, which forms a very low velocity basin. In addition, this particular location is where the Kettle River enters into the reservoir and has created very deep holes in which the sturgeon can retreat. With the Kettle River bringing in nutrients, and the reservoir creating the first significant velocity reduction to settle silts and nutrients within the reservoir, it appears a combination of factors may attract the sturgeon to this area. It also appeared that the sturgeon preferred areas with high levels of very fine bottom sediment, which indicates that areas with reduced bottom currents or the substrate itself was generally favored. The study also found that fish that had been placed in areas other than this preferred location moved extensively downstream and upstream to reach this area, some traveling as much as 31 miles upstream (University of Idaho 1992).

The data collected also showed that residence behavior might be quite lengthy in some preferred habitats. Fish caught in an area rich in sediments showed evidence of lengthy residence by red abdominal stains acquired from the red silts. Dark red stains over the entire ventral surface and mouth parts from the bottom composition indicated they were not transient and the fish had probably resided in that area for an extended length of time. It has been suggested that preferred areas might have resident populations that don't leave the area except for spawning activity. The substrate composition data collected was useful in demonstrating the general nature of habitat preference during the more sedentary period of the white sturgeon movement patterns.

Various fish were caught and released during the study. From the fish size data collected, it appears that reproduction has been occurring among the white sturgeon population in the reservoir/river system during the nearly 50 years in which they have existed in the Lake Roosevelt impoundment.

The above study was used as a reference for the type of habitat utilized by adult white sturgeon. Relatively little information is presently available on the substrate types and hydrodynamic interfaces within Lake Oroville. Small portions within the lake and upstream in the rivers may

provide the preferred habitat for adult sturgeon, but not enough information is currently available to determine the quantity and location of these potential habitats.

The *White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers upstream from Bonneville Dam* (2000-2001 annual progress report) was prepared for the Bonneville Power Administration in a continuing effort to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The report consisted of results of six different studies performed to evaluate the white sturgeon population within the Columbia River. Three of the studies were designed to evaluate the success of developing and implementing a management plan for enhancing production of white sturgeon in the reservoirs between the Bonneville and McNary dams. Each study utilized different population evaluation methods. One of the reports implemented a fish transplant supplementation plan from high-density to low-density populations. In October and November 2000, white sturgeon measuring 35-90 cm FL were transplanted to two upstream reservoirs. Transplanted fish will continue to be monitored in future years to determine success rates of population development using mark and recapture population estimates.

This same study also performed Young-of-Year (YOY) indexing to determine YOY recruitment relative to previous years. Sturgeons caught that were less than 31 cm FL were classified as YOY. In one reservoir a total of 144 sturgeon were captured, but only nine could be considered YOY. In the other reservoir, 63 sturgeon were collected with no YOY in the sample (Oregon DFW, 2002). At the completion of the study it was found that some recruitment was demonstrated in the downstream reservoirs, but no YOY were captured in the upstream reservoirs. This general pattern has been observed in previous sample years, indicating a consistently low level of recruitment in upper river reservoirs relative to lower river reservoirs. This information corroborates other findings that indicate low abundance of mature, reproductive adults in the upper reservoirs, and the belief that white sturgeon populations in these reservoirs is limited by poor recruitment resulting from hydro-system development (Oregon DFW, 2002).

This report also included a survey of the 2000 sport fishery from the Bonneville Dam upstream to the McNary Dam to estimate white sturgeon harvest. This study was used to determine if intense management of the sport fishery has kept the cumulative harvest at guideline levels, and whether the goal of rebuilding white sturgeon populations is being accomplished. Harvest estimates were made using counts of all bank anglers and sport fishing boats, and the catch per hour of these fishermen, from April 2000 to March 2001. Estimates of harvest from treaty Indian commercial fisheries also were accounted for. It was determined that harvest rates exceeded the harvest guidelines, which indicates that conservative harvest management strategies, as well as trawl and haul stocking efforts, has resulted in the rebuilding of the white sturgeon populations within these reservoirs.

The Columbia and Snake River studies were conducted to evaluate the current status of the white sturgeon populations found within the area, and if current management practices maintained the populations. These studies also will be used to determine if transporting sturgeon is an efficient management practice.

CONCLUSIONS

The above studies were used to assess white sturgeon habitat preferences for spawning, as well as for adult holding. The above studies also assessed the status of sturgeon populations above hydroelectric facilities and potential management practices for continuing to maintain healthy sturgeon populations for sport harvest. It was found that the particular habitat that sturgeon prefer to spawn in occurred in the swiftest water available and on substrates consisting mainly of cobble, boulder, and bedrock. Spawning occurred in water temperatures ranging from 12°C - 18°C (53.6°F - 64.4°F) and at water depths of 4-24 meters (13 - 79 feet). Adult sturgeon preferred holding habitats occurring at the low water interface between the reservoir and river, which forms a low velocity basin. In addition, sturgeon tend to prefer very deep holes in which they can retreat. It also appeared that the sturgeon preferred areas with high levels of very fine bottom sediment.

Presently, it is believed that a self-sustaining population of white sturgeon does not occur in Lake Oroville. This study is being used to determine if Lake Oroville and its upper river tributaries have suitable habitat to maintain a sturgeon population, which includes spawning and adult holding habitat. As presented in the above discussions, it has been determined that there may be small portions of the North Fork Feather River and Middle Fork Feather River that provide suitable spawning habitat for white sturgeon. It has not been determined how much or under what hydrologic conditions habitat may be available. Because white sturgeon have not been stocked since 1998, the lack of any substantial reported catches indicate that Lake Oroville did not achieve a self-sustaining population. White sturgeon spawning habitat may be available within the Diversion Pool, but it is unlikely that the amount of this habitat would support a self-sustaining population.

REFERENCES

- E. Brannon, A. Setter. 1992. Movements of White Sturgeon in Lake Roosevelt, Final Report 1988-1991. Prepared for U.S. Department of Energy Bonneville Power Administration, Division of Fish and Wildlife, Contract No. DE-B179-89BP9729, Project No. 89-44.
- Fisk, L. 1963. The Resource Agency of California Department of Fish and Game, The Shasta Lake Sturgeon Fishery, Inland Fisheries Administrative Report No. 63-12.
http://www.dfg.ca.gov/hcpb/images/anml_accts/grst_sm.jpg>Green Sturgeon
- Parsley, M.J., Beckman, L.G., McCabe, G.T. 1993. Spawning and Rearing Habitat Use by White Sturgeon in the Columbia River Downstream from McNary Dam. Transactions of the American Fisheries Society 122:217-227.
- Ward, David L. – Oregon Department of Fish and Wildlife, 2002, White Sturgeon Mitigation and Restoration in the Columbia and Snake Rivers Upstream from Bonneville Dam – Annual Progress Report April 2000 –March 2001, Report to Bonneville Power Administration, Contract No. 0004005, Project No. 198605000, 155 electronic pages (BPA Report DOE/BP-0004005-1).

INVESTIGATIVE NOTES AND PERSONAL COMMUNICATIONS

Included below are the personal communications that took place with individuals at various resource agencies to determine if information was available for white sturgeon management in any reservoir in California.

1. E-mail sent on Wednesday, 10/9/2002 at 11:56 AM to Eric See (DWR) from Allison Niggemyer.

Hi Eric,

How are things going? I have a few questions for you regarding Task 2D of SP-F3.1. This task is the task in which we are summarizing the known information regarding white sturgeon management activities in CA reservoirs and other western US reservoirs and determining the applicability of those activities to Lake Oroville. We have a list of habitat requirements for white sturgeon extracted from the available literature, and we were wondering if you could take a look at the description of the habitat characteristics and let us know if Lake Oroville (including the tributaries in the section of the lake that is below the high water mark) contains this type of habitat. If you know of areas in the lake or the arms of the lake that contain these types of habitat, could you let me know where the habitat is located? For spawning, white sturgeon prefer habitat with the following characteristics:

1. Water velocity of 0.8 to 2.8 m/s
2. Substrates consisting of boulders, large cobble, and bedrock
3. Water depths of 4 - 24 meters

If you could pass along any information regarding areas in the lake that meet these criteria, that would be great. Additionally, the general habitat white sturgeon prefer include:

1. Low velocity basins with deep holes where rivers enter the reservoir
2. High levels of fine bottom sediment
3. Areas with reduced bottom currents

Again, if you know of areas that meet these criteria and could pass along that info, we'd really appreciate it.

Thanks for your time Eric and feel free to call if you have any questions.

2. E-mail sent on Wednesday 10/9/2002 at 11:33 AM to Randy Benthin (DFG) from Allison Niggemyer.

Hello Randy,

My name is Allison Niggemyer and we spoke briefly on the phone on Monday, October 7th, regarding sturgeon management in California reservoirs. I just wanted to summarize our conversation to make sure I captured the information correctly. My notes suggest that there is little active sturgeon management in CA reservoirs in general. The reservoir management activities relating to sturgeon that you are aware of are the activities in Lake Shasta. Historically, prior to PG&E's building of Pit 6 and Pit 7, there was good reproduction of white sturgeon in the Pit River arm of Lake Shasta, and in the 1950s and 1960s the sturgeon fishery was a popular fishery. However, the building of Pit 6 and 7 apparently eliminated a majority of the available spawning habitat, resulting in a reduced population and a reduced fishery. A pen-rearing program for white sturgeon was begun at Lake Shasta and was successful for growing sturgeon, but prior to sturgeon planting, it was determined by the DFG pathologist not to stock the sturgeon in the lake.

This decision was made because there is a virus found in aquacultured sturgeon, which may or may not occur in the wild. If it did not occur in the wild, the pathologist did not want cultured sturgeon spreading it to the wild. (Randy, could you clarify something for me here? I have heard that some cultured sturgeon were planted and then stocking was halted as a result of the concerns regarding spread of the virus. I want to get the correct chronology). Additionally, your group is currently working on drafting a report describing the historical sturgeon fishery in Lake Shasta.

Currently your group is working to develop a proposal to re-introduce white sturgeon into Lake Shasta. However, due to disease concerns, one of the things your group is hoping to determine is whether or not the sturgeon virus is present in the wild. One of the reasons it is difficult to determine this is that the virus may be lethal to white sturgeon juveniles, and if so, living white sturgeon adults are either resistant to the virus or were not exposed to the virus at earlier lifestages. In order to try to determine whether the virus is present in the wild, larval white sturgeon have been captured in rotary screw traps in the Sacramento River (at Red Bluff and at GCID) and raised in captivity to try to gain additional information about the presence of the virus. However, it can be difficult to differentiate between white and green sturgeon in the earliest lifestages and when the larval sturgeon were raised, they turned out to be green sturgeon. White sturgeon in the early lifestages appear to rear in the Sacramento River for only a short time, drifting and migrating quickly downstream to the estuaries, making it difficult to capture white sturgeon in the earliest lifestages (prior to virus exposure). The tentative proposal for re-introduction of white sturgeon in to Lake Shasta includes capture of 1 to several hundred wild white sturgeon juveniles (under 4 ft in length) in the upstream portions of the Sacramento River and transplanting them into Lake Shasta following inspection by the pathologist.

I just wanted to make sure that I had recorded the correct information and to thank you for your time on Monday. Additionally, I would like to request a copy of both the report and the proposal when they become available, if possible.

3. E-mail forwarded on Monday 10/7/2002 12:05 PM to Allison Niggemyer from Mike Mainz (DFG).

Mike: I believe a small number of Green and White Sturgeon were stocked in Oroville in the late 1960's, just after the reservoir filled. I saw only one or two of these caught in my years at Oroville (1972-1981), and these were not legal-size fish. I imagine there are still Sturgeon in the lake, but tough to fish! Sorry for the lack of more definitive info.

John Hiscox

>>> Mike Mainz 10/04/02 07:35AM >>>

John. Do you know about any sturgeon stocked into Lake Oroville?

>>> John Hiscox 09/27/02 08:08AM >>>

Mike et. al.: I don't know of any Sturgeon populations in my inland waters. Good fishery in Lower Yuba River at certain times of the year, but I don't know whether there is an ongoing management program for that water. Sorry for the lack of info. John Hiscox

>>> "Allison Niggemyer" <niggemyer@swri.net> 09/23/02 04:17PM >>>

Hi Mike, Eric, and Cesar,

How are things going? As you know, we are starting to implement the literature review sections of some of the study plans and I am currently in search of some information to help with the implementation of Task 2D of SP-F3.1. This task is supposed to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are to summarize information about

mitigation/enhancement activities and monitoring results describing the success of those activities. I have spoken with Eric See at DWR and he is going to check with Larry Hanson (who I think is with DFG) regarding information from Lake Shasta, as apparently whites were stocked there a few years ago. I was wondering if any of you knew of any other reservoirs in California that had active sturgeon management programs. I was able to find some information regarding sturgeon management in the Columbia River system, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

4. *E-mail sent on Thursday 10/3/2002 at 9:24 AM to Dennis Lee (DFG) from Allison Niggemyer.*

Dear Dennis,

I just wanted to thank you for your response to my question regarding sturgeon management in CA reservoirs. Additionally, I was wondering if it would be possible to get my hands on an Inland Fisheries Information Leaflet that you and Ivan Paulsen authored in 1999 regarding water level fluctuation criteria for black bass in CA reservoirs. We are interested in using the criteria to evaluate the effects of water reductions on bass in Lake Oroville for the FERC relicensing, but I have been unable to locate the publication either on-line or through the DFG Pat Montalvo at the DFG publications office. The citation I am looking for is: Lee, D.P., and I.L. Paulsen. 1999. Water Level Fluctuation Criteria for Black Bass in California Reservoirs. California Department of Fish and Game, Reservoir Research and Management Project - Information Leaflet No. 12.

Thanks so much for your time and assistance,
Allison

-----Original Message-----

From: Dennis Lee [mailto:DLee@dfg.ca.gov]
Sent: Tuesday, October 01, 2002 8:27 AM
To: Allison Niggemyer
Cc: Larry Hanson; William Cox
Subject: Re: Summary of information regarding sturgeon management in California reservoirs

Allison;

Your summary is correct. I think there still exists a very minor fishery for sturgeon in Lake Shasta (the population is small) and the Department occasionally gets requests to stock additional fish. The last sturgeon I personally saw caught by an angler from Lake Shasta was in the early 90's (about 125 pounds), although Larry Hanson is the best source for current information. I am unaware of any other large multi-purpose reservoir in California that contains an existing or remnant sturgeon fishery.

If you need more information on the virus issue, please contact Dr Bill Cox.

Dennis

5. *E-mail sent on Tuesday 10/1/2002 at 1:06 PM to Allison Niggemyer from Ray Schaffter (DFG).*

Ms. Niggemyer, Compared to the Columbia River, Sturgeon have never been a major component of reservoir fisheries or fish populations (unlike upstream impoundments in the Columbia River). Evidently in Shasta Reservoir, some white sturgeon (*Acipenser transmontanus*) were impounded during construction of the dam. These fish, for some time, evidently continued to spawn in the

Pit River arm of the reservoir and both legal and sublegal (<40 inches total length) sturgeon were taken by anglers (Fisk 1963---I'm FAXing you a copy). This Administrative report is the only study on reservoir resident sturgeon in California of which I am aware. Evidently, this population has since become extinct or remains present a very low population. In no other reservoir in California were sturgeon known to be trapped by dam construction.

Some small, white sturgeon were released into Folsom Reservoir after its construction (1950s-60s). We know this only from a list of tags that were applied to these fish that we found last winter while going through old boxes of data looking for 1954 San Pablo Bay sturgeon tagging data. There was no information on the recovery of any of these tagged fish and they probably perished or may have left the reservoir during flood control releases. There was no information on the source of these fish. Also, during the late 1950s or early 1960s, some small white sturgeon were planted into Millerton Reservoir (San Joaquin River). The source of these fish was evidently the Federal CVP pumping plant near Tracy (this also could have been the source of the Folsom planted fish). There are no records of this Millerton release; this information came verbally from a long-retired biologist living in the Fresno area. Evidently a few of these fish were caught but no information is available. There is no evidence of any reproduction of these fish in Millerton Reservoir, in fact there is no written information of this release and possible subsequent take of any of these fish in DFG files (Randy Kelly, DFG, personal conversation).

Recently, within the Department, there has been some interest in stocking small white sturgeon, now obtainable from aquaculturists, into Shasta Reservoir. This has not been done because of 2 viruses present in aquaculture stocks that have not been confirmed in wild California populations (Hedrick et al 1990, 1991). I believe this prohibition will probably stand for some time.

To clear the air about green sturgeon (*Acipenser medirostris*); they have never been observed in any California reservoir, and to the best of my knowledge, are not present in any impoundments of the Columbia River. Given the fact that under the present flow regime of the Sacramento River, they presently migrate further upstream for spawning than do white sturgeon, it seems that some would have been trapped as were white sturgeon. The fact that they have never been noticed there (or in Columbia River impoundments) suggests to me that this more marine oriented species cannot survive only in fresh water.

If you have any more questions, feel free to call.

Hedrick, R.P., J. M. Gruff, T. McDowell and W. H. Wingfield. 1990. An Iridiovirus infection of the integument of the white sturgeon *Acipenser transmontanus*. *Dis. Aquatic Organisms* 8:39-44.

Hedrick, R. P., T. S. McDowell, R. Rosemark, D. Aronstein and C. N. Lannen. 1991. Two Cell Lines from White Sturgeon. *Trans. Am. Fish. Soc.* 120:528-534.

FAXING NOW!!!!

6. *E-mail sent Tuesday 10/1/2002 at 8:27 AM from Dennis Lee (DFG) to Allison Niggemyer.*

Allison;

Your summary is correct. I think there still exists a very minor fishery for sturgeon in Lake Shasta (the population is small) and the Department occasionally gets requests to stock additional fish. The last sturgeon I personally saw caught by an angler from Lake Shasta was in the early 90's (about 125 pounds), although Larry Hanson is the best source for current information. I am unaware of any other large multi-purpose reservoir in California that contains an existing or remnant sturgeon fishery.

If you need more information on the virus issue, please contact Dr Bill Cox.

Dennis

7. *E-mail sent Monday 9/30/2002 at 11:00 AM to Dennis Lee (DFG) from Allison Niggemyer.*

Dear Dennis,

My name is Allison Niggemyer and we spoke briefly on the phone on Friday, September 27th regarding sturgeon management in California reservoirs. I just wanted to summarize our conversation to make sure I captured the information correctly. My notes suggest that there is currently no active inland (reservoir) sturgeon management program of which you are aware. Apparently Lake Shasta had a sturgeon population that was isolated in the lake when the dam was built, and there was a fishery for sturgeon. Subsequently, cultured sturgeon were introduced into Lake Shasta, but the DFG fish pathologist determined that no further stocking should occur as the result of a virus that infects aquacultured stocks. Lastly, you recommended I contact Larry Hanson to see if he had any additional information.

I just wanted to make sure that I had recorded the correct information and to thank you for your time on Friday.

Thanks again,
Allison

8. *E-mail sent Friday 9/27/2002 at 2:35 PM from Randal Kelly (DFG) to Allison Niggemyer.*

Allison

I do not know of any active management activities in CA reservoirs for sturgeon. They have been planted and observed in the past in these reservoirs, and some may have been trapped when the reservoirs were first constructed, but I don't have any other information or contacts that I know of that might help you.

Randy Kelly

9. E-mail sent Friday 9/27/2002 at 2:06 PM from Gary Stacey (DFG) to Randy Benthin (DFG), copied to Allison Niggemyer.

Randy: Would you please have one of staff contact Ms. Niggemeyer directly to answer her information requests.

Thanx.

Gary

10. *E-mail sent Friday 9/27/2002 at 2:02 PM to Randy Kelly (DFG) from Allison Niggemyer.*

Dear Randy,

My name is Allison Niggemyer and I work for Surface Water Resources, Inc. in Sacramento. I am writing because I am currently in search of information regarding sturgeon management programs in California reservoirs, and Dave Kohlhorst recommended that I contact you. We are serving as the fisheries consultants to DWR for the relicensing of the Oroville Dam, and one of our relicensing tasks is to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are interested in summarizing information (primarily reports) about mitigation/enhancement activities and monitoring results describing the success of those activities. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I have been successful in finding information regarding sturgeon management in the Columbia River system reservoirs, but I was hoping for some information from a California system that was more similar to

Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thank you so much for your time,

Allison

11. E-mail sent Friday 9/27/2002 at 1:58 PM to Gary Stacey (DFG) from Allison Niggemeyer.

Dear Gary,

My name is Allison Niggemeyer and I work for Surface Water Resources, Inc. in Sacramento. I am writing because I am currently in search of information regarding sturgeon management programs in California reservoirs, and Dave Kohlhorst recommended that I contact you. We are serving as the fisheries consultants to DWR the for the relicensing of the Oroville Dam, and one of our relicensing tasks is to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are interested in summarizing information (primarily reports) about mitigation/enhancement activities and monitoring results describing the success of those activities. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I have been successful in finding information regarding sturgeon management in the Columbia River system reservoirs, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thank you so much for your time,

Allison

12. *E-mail sent Friday 9/27/2002 at 1:50 PM to Ray Schaffter (DFG) from Allison Niggemeyer.*

Hi Ray,

My name is Allison Niggemeyer and we spoke briefly this morning. As I mentioned in our conversation, I am currently in search of information regarding sturgeon management programs in California reservoirs, and Joe Cech recommended that I contact you. We are serving as the fisheries consultants to DWR the for the relicensing of the Oroville Dam, and one of our relicensing tasks is to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are interested in summarizing information (primarily reports) about mitigation/enhancement activities and monitoring results describing the success of those activities. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I have been successful in finding information regarding sturgeon management in the Columbia River system reservoirs, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thank you so much for your time,

Allison

13. *E-mail sent Friday 9/27/2002 at 1:42 PM to Dave Kohlhorst (DFG) from Allison Niggemeyer.*

Dear Dave,

Thank you for your response to my request for information regarding sturgeon management in California reservoirs. I will contact Gary, Randy, and Dennis this afternoon.

Thanks again for your time,
Allison

14. *E-mail sent Friday 9/27/2002 at 11:39 AM to Allison Niggemyer from Dave Kohlhorst (DFG).*

Allison,

To my knowledge, the only sturgeon management in reservoirs in California recently has been some stocking of fish purchased from aquaculturists. I know this was done in Shasta Lake and maybe elsewhere, such as Millerton. I suggest you contact Gary Stacey in Redding (gstacy@dfg.ca.gov); Randy Kelley in Fresno (rkelley@dfg.ca.gov); and, for a state-wide perspective, Dennis Lee (dlee@dfg.ca.gov).

Dave Kohlhorst

15. *E-mail sent Friday 9/27/2002 at 8:08 AM from John Hiscox (DFG) to Allison Niggemyer and Mike Meinz.*

Mike et. al.: I don't know of any Sturgeon populations in my inland waters. Good fishery in Lower Yuba River at certain times of the year, but I don't know whether there is an ongoing management program for that water. Sorry for the lack of info. John Hiscox

16. *E-mail sent Wednesday 9/25/2002 at 11:24 AM from Chuck Knutson (DFG) to Allison Niggemyer.*

Allison,

We have green and white sturgeon in the Sacramento-San Joaquin River system and green sturgeon in the Klamath River. As for reservoirs, there are reports of a few sturgeon being caught behind dams like Shasta and Folsom. I don't know about Oroville.

Dave Kohlhorst, who works out of DFG's Bay-Delta Fisheries Project in Stockton, is the best contact on sturgeon in California. Call (209) 948-7800 or email him at dkohlhor@delta.ca.gov

Chuck

17. *E-mail sent Wednesday 9/25/2002 at 10:06 AM from Joe Cech (UCD) to Allison Niggemyer.*

Hi, Allison.

I would suggest contacting Mr. Dennis Lee (regarding California reservoir management) and Mr. Ray Schaffter (regarding sturgeon management), both of whom are with the California Department of Fish and Game.

Best wishes,
Joe Cech

18. *E-mail sent Tuesday 9/24/2002 at 6:03 PM from Serge Doroshov (UCD) to Allison Niggemyer.*

Dear Allison,

The only thing I know about sturgeon in California reservoirs is the presence of small population (of large fish) in the Shasta Lake. They were apparently cut-off by the dam long ago and do not reproduce. I copy this message to Dave Kohlhorst (California Department of Fish and Game) who is a most experienced researcher in sturgeon stock management in California – he might know more about the reservoirs in California. In general, white sturgeon do well in the reservoirs (as far as the food and appropriate oxygen (> 5 ppm) are available), but they rarely or never reproduce in the reservoirs. They need river currents and appropriate "hard" substrates (gravel, rocks, etc) to spawn. The same is true for the other sturgeons and North American paddlefish. You may be interested to contact Blaine Parker (Columbia River Inter-Tribal Fish Commission, Portland) who is involved in sturgeon management in the Columbia River reservoirs. His phone number 503-731-1268, email: parb@critfc.org

Good luck with your summary and let me know if you have any specific questions on sturgeon biology.

Serge Doroshov
Animal Science

19. *E-mail sent Tuesday 9/24/2002 at 2:25 PM to Eric Theiss (NOAA) from Allison Niggemyer.*

Hi Eric,

Thanks for the suggestion to contact Joe Cech regarding the sturgeon management in CA reservoirs. I'll drop him a line this afternoon. We've spoken briefly with Dave regarding the passage assessment methodology and it's good to hear that you two will be involved. We'll continue diving into the Orsborn publication and we hope to get a group together for the initial field data collection in the not too distant future.

Thanks for your input and we'll be in touch regarding the passage assessment,
Allison

20. *E-mail sent Tuesday 9/24/2002 at 8:34 AM from Eric Theiss (NOAA) to Allison Niggemyer.*

Hi Allison,

I am busy but doing well thanks. Dave and I would like to be involved in all phases of the 3.1 barrier stuff that you are doing. Dave is already digging into the Orsborn pub. As far as sturgeon, I would get in touch with Joe Cech definitely (jjcech@ucdavis.edu). As far as California goes he would know more than anyone.

Eric

21. *E-mail sent Tuesday 9/24/2002 at 7:02 AM from Mike Mainz (DFG) to Allison Niggemyer.*

I will look but it won't be until next week. Also try Chuck Knutson at (916) 445-3459 or cknutson@dfg.ca.gov
mike mainz

22. *E-mail sent Monday 9/23/2002 at 4:17 PM to Mike Mainz (DFG), Eric Theiss (NOAA), and Cesar Blanco(DFG) from Allison Niggemyer.*

Hi Mike, Eric, and Cesar,

How are things going? As you know, we are starting to implement the literature review sections of some of the study plans and I am currently in search of some information to help with the implementation of Task 2D of SP-F3.1. This task is supposed to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are to summarize information about mitigation/enhancement activities and monitoring results describing the success of those activities. I have spoken with Eric See at DWR and he is going to check with Larry Hanson (who I think is with DFG) regarding information from Lake Shasta, as apparently whites were stocked there a few years ago. I was wondering if any of you knew of any other reservoirs in California that had active sturgeon management programs. I was able to find some information regarding sturgeon management in the Columbia River system, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thanks for your time,
Allison

23. *E-mail sent Monday 9/23/2002 at 1:15 PM to Alicia Seescholtz (DWR) from Allison Niggemyer.*

Hi Alicia,

How are things going? Have you had a busy summer? We are starting to implement the literature review sections of some of the study plans and I am currently in search of some information to help with the implementation of Task 2D of SP-F3.1. This task is supposed to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are to summarize information about mitigation/enhancement activities and monitoring results describing the success of those activities. I have spoken with Eric See and he is going to check with Larry Hanson (who I think is with DFG) regarding information from Lake Shasta, as apparently whites were stocked there a few years ago. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I was able to find some information regarding sturgeon management in the Columbia River system, but I was hoping for some info from a California system that was more similar to Oroville. If you could pass along any information or contacts you are aware, that would be greatly appreciated!

Thanks Alicia and I hope things are going well,
Allison

24. *E-mail sent Monday 9/23/2002 at 1:28 PM from Alicia Seescholtz (DWR) to Allison Niggemyer.*

Hi Allison-

Sorry I haven't heard of anything in California. The closest is Columbia and the rest (sturgeon other than whites or greens) seem to be in Missouri and Mississippi. Serge Doroshov might be one lead as he is a culturalist along with his many other talents. Presently, he is working on greens in the Klamath. I'm not sure how easy he will be able to get a hold of SIDoroshov@UCDavis.Edu ... I don't know him, just about him.

Sorry I can't be more helpful,
Alicia

25. *E-mail sent Monday 9/23/2002 at 3:59 PM to Alicia Seescholtz (DWR) from Allison Niggemyer.*

Hi Alicia,

Thanks for your response. I haven't had much luck finding anything in CA - only the BPA stuff up on the Columbia. I will try the man you recommended to see if he has any additional information.

Thanks!
Allison

26. *E-mail sent Monday 9/23/2002 at 1:14 PM to Ted Sommer (DWR) from Allison Niggemyer.*

Hi Ted,

How are things going? We are starting to implement the literature review sections of some of the study plans and I am currently in search of some information to help with the implementation of Task 2D of SP-F3.1. This task is supposed to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are to summarize information about mitigation/enhancement activities and monitoring results describing the success of those activities. I have spoken with Eric See and he is going to check with Larry Hanson (who I think is with DFG) regarding information from Lake Shasta, as apparently whites were stocked there a few years ago. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I was able to find some information regarding sturgeon management in the Columbia River system, but I was hoping for some info from a California system that was more similar to Oroville. If you could pass along any information or contacts you are aware of, that would be greatly appreciated!

Thanks Ted and I hope things are going well,
Allison

27. *E-mail sent Monday 9/23/2002 at 1:21 PM to Allison Niggemyer from Ted Sommer (DWR).*

No, not to my knowledge.

Ted

28. *E-mail sent Monday 9/23/2002 at 4:10 PM from Allison Niggemyer to Serge Doroshov (UCD).*

Dear Serge,

My name is Allison Niggemyer and I work for Surface Water Resources, Inc. in Sacramento. You were recommended to me by Department of Water Resources biologists Ted Sommer and Alicia Seesholtz. We are serving as the fisheries consultants to DWR for the relicensing of the Oroville Dam, and one of our relicensing tasks is to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are interested in summarizing information about mitigation/enhancement activities and monitoring results describing the success of those activities. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I was able to find some information regarding sturgeon management in the Columbia River system, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thank you so much for your time,

Allison

29. *E-mail sent Tuesday 9/24/2002 at 3:49 PM to Bradley Cavallo (DWR) and Michael Perrone (DWR) from Allison Niggemyer.*

Hi Brad and Michael,

I meant to ask you guys about this when we met this morning, but I forgot. I am on the hunt for some information to help with the implementation of Task 2D of SP-F3.1. This task is supposed to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are to summarize information about mitigation/enhancement activities and monitoring results describing the success of those activities. I have had some luck finding stuff on river systems (mostly the Sac) but no luck finding information from reservoirs. I have spoken with Eric See and he is going to check with Larry Hanson (who I think is with DFG) regarding information from Lake Shasta, as apparently whites were stocked there a few years ago. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I was able to find some information regarding sturgeon management in the Columbia River system reservoirs, but I was hoping for some info from a California system that was more similar to Oroville. If you could pass along any information or contacts you are aware, that would be greatly appreciated!

Thanks and it was good to see you both today

Allison

30. *E-mail sent Tuesday 9/24/2002 at 5:09 PM to Mike Mainz (DFG) from Allison Niggemyer.*

Hi Mike,

Thanks for your response regarding the inquiry for information about sturgeon management in CA reservoirs. I'll drop Chuck Knutson a line this evening.

Thanks again,

Allison

31. E-mail sent Friday 9/27/2002 at 10:45 AM from Allison Niggemyer to Serge Doroshov (UCD).

Dear Serge,

Thank you so much for your response regarding sturgeon management in California reservoirs and for forwarding my request on to Dave Kohlhorst. I really appreciate it.

Thanks again for your time,
Allison

32. E-mail sent Friday 9/27/2002 at 10:47 AM from Allison Niggemyer to Joe Cech (UCD).

Dear Dr. Cech,

Just wanted to thank you for your recommendation regarding contacts for sturgeon management in CA reservoirs. I will contact Dennis and Ray this afternoon to see if they can provide any additional information.

Thanks again for your time,
Allison

33. *E-mail sent Friday 9/27/2002 at 10:48 AM from Allison Niggemyer to Chuck Knutson (DFG).*

Dear Chuck,

I just wanted to say thanks for your response to my request for information on sturgeon management in CA reservoirs. I will contact Dave Kohlhorst to see if he can provide any additional information.

Thanks again for your time,
Allison

34. *E-mail sent Friday 9/27/2002 at 10:58 AM from Allison Niggemyer to Dave Kohlhorst (DFG).*

Dear Dave,

My name is Allison Niggemyer and I work for Surface Water Resources, Inc. in Sacramento. I am writing because I am currently in search of information regarding sturgeon management programs in California reservoirs, and Chuck Knutson and Serge Doroshov recommended that I contact you. We are serving as the fisheries consultants to DWR for the relicensing of the Oroville Dam, and one of our relicensing tasks is to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are interested in summarizing information (primarily reports) about mitigation/enhancement activities and monitoring results describing the success of those activities. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I have been successful in finding information regarding sturgeon management in the Columbia River system reservoirs, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thank you so much for your time,

Allison

35. *E-mail sent Tue 9/24/2002 5:13 PM from Allison Niggemyer to Chuck Knutson (DFG).*

Dear Chuck,

My name is Allison Niggemyer and I work for Surface Water Resources, Inc. in Sacramento. I am writing because I am currently in search of information regarding sturgeon management programs in California reservoirs, and Mike Mainz suggested I contact you. We are serving as the fisheries consultants to DWR for the relicensing of the Oroville Dam, and one of our relicensing tasks is to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are interested in summarizing information (primarily reports) about mitigation/enhancement activities and monitoring results describing the success of those activities. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I was able to find information regarding sturgeon management in the Columbia River system reservoirs, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thank you so much for your time,

Allison

36. E-mail sent Tuesday 9/24/2002 at 5:08 PM from Allison Niggemyer to Joe Cech (UCD).

Dear Dr. Cech,

My name is Allison Niggemyer and I work for Surface Water Resources, Inc. in Sacramento. I am writing because I am currently in search of information regarding sturgeon management programs in California reservoirs. We are serving as the fisheries consultants to DWR the for the relicensing of the Oroville Dam, and one of our relicensing tasks is to summarize any available information on sturgeon (white or green) management in California reservoirs. Specifically, we are interested in summarizing information (primarily reports) about mitigation/enhancement activities and monitoring results describing the success of those activities. I was wondering if you knew of any reservoirs in California that had active sturgeon management programs. I was able to find information regarding sturgeon management in the Columbia River system reservoirs, but I was hoping for some information from a California system that was more similar to Oroville. If you could pass along any information or contacts you could recommend, that would be greatly appreciated!

Thank you so much for your time,

Allison

37. *E-mail sent Friday 10/18/02 from Eric See (DWR) to Allison Niggemyer.*

Hi Allison,

The North and Middle Forks of the Feather, as well as the West Branch contain this type of habitat within the reservoir for a portion of the year, particularly in the winter and spring when flows are higher and the lake is lower. I do not know exactly how much, but if you look around you would find portions of these major tributaries that meet these criteria. However, I do not know if a threshold exists to determine whether this would be suitable for sturgeon spawning. For example, if you have a segment of the river that is primarily shallow riffles, short runs, and then pools, you are likely going to find some portion of each pool, and even a run here and there that meets the criteria. Even if it is only for a short distance. Would that constitute suitable habitat? As the lake comes up in the winter and spring, as it floods the riverbed it will create these it will create these criteria for a short time as well.

I guess the best thing I can say is that portions of the major tributaries meet the criteria for at least part of each year.

The Diversion Pool, especially in the upper reaches near the dam, definitely meets this criteria, on a more regular basis.

-E

p.s. DFG said they put the updated fluctuation paper in the mail toady, I will forward it to you immediately.